

IRIS

DC1100/DC1100E

Business Class Cable Modem Termination System Installation and Operational Guide

Coaxial Networks, Inc.

P/N DC1100-UG

Revision: 4.13

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1. The seal or serial number on the Product have been tampered with;
2. The Product's case has been opened; or
3. There has been any attempted or actual repair or modification of the Product by anyone other than a CNI authorized service provider.

C. The limited warranty does not cover defects in appearance, cosmetic, decorative or structural items, including framing, and any non-operative parts.

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Coaxial Networks, Inc.
4800 Great America Parkway
Suite 300
Santa Clara, CA 95054
U.S.A.
Attn: Customer Service.

Introduction

Coaxial Networks provides an integrated solution to the hospitality businesses, apartment complexes and broadband service providers for deploying Internet services. The solution is geared towards cutting down challenges such as cost and rack space faced by the hotel operators.

IRIS DC1100 is a very compact and cost effective solution. Using IRIS, Network or System Integrators can deploy blazing fast Internet over existing coax and cable TV infrastructure. The system comprises of all the hardware and software elements tied together to provide one comprehensive solution. Utilizing the existing cable infrastructure, which means no costly rewiring or downtime; operators can quickly deploy these services.

The core elements of the system are DOCSIS 1.0/1.1 compatible hardware system, auto provisioning of subscribers and services, bandwidth and policy management. Coaxial Networks provides the complete solution including the CMTS, Software and Cable Modems. The comprehensive package enables the service providers to roll out services in the untapped hospitality, MDU and MTU markets.

Key Benefits

No New Wiring

IRIS DC1100 utilizes the existing cable infrastructure, which means no new costly rewiring. The system can be deployed without any downtime so crucial for the hospitality business.

Single Server Broadband Solution

IRIS DC1100 is a single server broadband solution, with which you can deploy and manage your broadband IP network. All the required services such as DHCP, NAT, Firewall (IP Filtering) are integrated in the IRIS DC1100. Each receive channel of IRIS is geared towards provisioning 250 cable modems. Actual network planning is required to determine how many subscriber cable modems you should put on each receive channel.

Remote Administration and Management

IRIS DC1100 provides remote administration using the Web (HTTP). A command line interface is provided for users wishing to use the advanced features through Telnet or Serial port. The system can be monitored and configured using SNMP.

Standards Based

IRIS DC1100 utilizes the DOCSIS based standards and protocols. You will not be dealing with any proprietary solution. DOCSIS standard was created to enable data over the cable TV so that both data and video can coexist on the same coax cable.

Installation Requirements

To successfully install and configure the IRIS DC1100, you will need the following:

PC Workstation Requirement

- Ethernet network Interface
- TCP/IP network protocol installed
- Terminal emulation or Telnet software for configuring IRIS via your PC's serial port or network before placing it into service on a network. HyperTerminal is such software included in Windows operating system.

Network Service Provider Requirements

Your Network Service provider should provide the following:

- An uplink connection to the Internet provided by a NSP
- The NSP equipment must have output of 10/100 Ethernet port.
- One Static IP Address
- Gateway Address
- Subnet mask
- DNS address

Package Contents

Your package should contain the items listed below. If you determine anything to be damaged or missing, please contact the seller from whom the equipment was purchased.

- One IRIS DC1100
- One IRIS DC1100 Documentation
- One AC power supply cord
- Mounting Brackets with screws
- One RS232 cross-over cable
- One Ethernet Cable

IRIS Rear Panel Connections

The diagram below illustrates the relevant rear panel ports and connections on the IRIS.

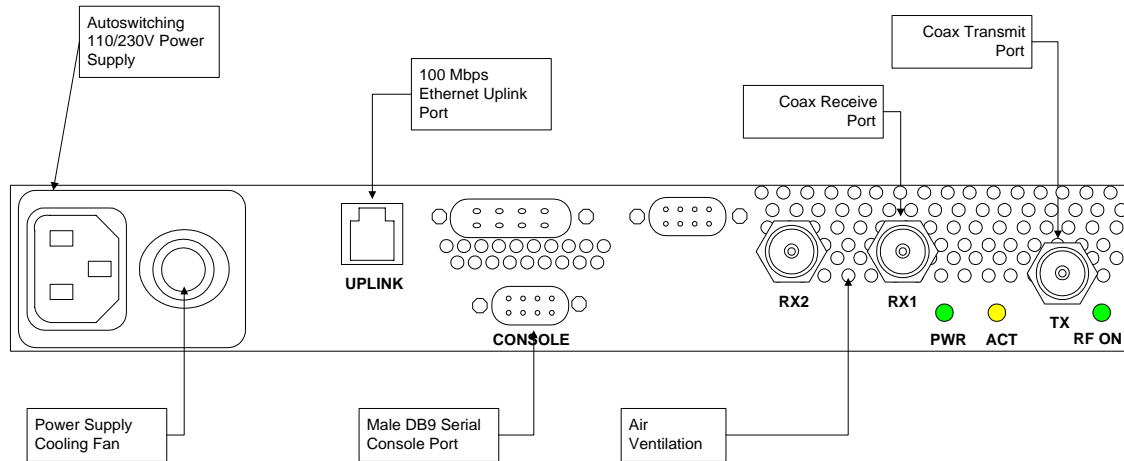


Figure 1 IRIS Rear Panel

IRIS Rear Panel consists of the following connectors and labels

1. Auto switching 110V/230V power supply connector
2. Female 'F' Connector for coax Transmit
3. Female 'F' connector for coax Receive channel 1
4. Female 'F' connector for coax Receive channel 2 (for DC1200 models only)
5. Uplink Ethernet RJ-45 port
6. Serial console port
7. LEDs:
 - Power (PWR) LED: Green when the power is connected and the system power up.
 - Activity (ACT) LED: Amber/Yellow LED Blinks indicating Up Stream data transfer is active.
 - RF ON LED: Green LED is lit when the Up converter is successfully powered on.
8. Rack mounting Ears (not shown): IRIS chassis has a provision for mounting the chassis backwards if customer desires.

The above-mentioned connectors are mainly required for configuration and operation of IRIS. The rear panel may contain other connectors for future features and the user should currently ignore them.

IRIS Front Panel

The diagram below illustrates the front panel controls of the IRIS.

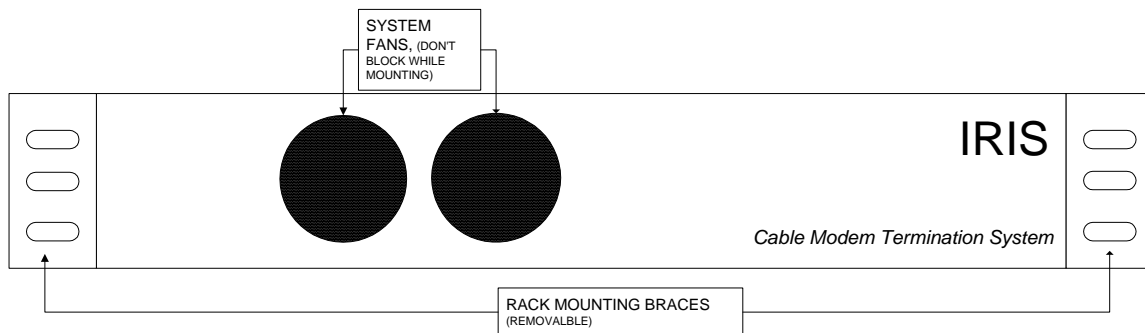


Figure 2 IRIS Front Panel

The front panel has no indicators or controls.

1. Removable rack mounting braces for 19" rack mounting.
2. Intake openings for the system cooling fans for the IRIS chassis

Both Front panel and rear panel have vents for system fan, care should be taken that these vents are not blocked during installation.

Mounting the IRIS Unit

The IRIS system can be mounted on a 19" Floor mounted Rack or 19" Wall Mount Rack with other equipment. In the absence of a 19" rack, you can mount the IRIS unit flat on the wall with the same mounting brackets supplied with the unit. The screws are provided to attach these braces to the chassis. However you will need to provide appropriate screws to secure the chassis to the wall. If you have a dry wall, recommended screws are hollow wall anchor screws. Always check your local code for compliance.

Mounting on standard 19" Rack with IRIS connectors in the Front

Use the supplied screws to attach the mounting brackets to the sides of the unit in the front for mounting IRIS on a 19" rack. Your rack supplier usually supplies the screws required for mounting.

Mounting on standard 19" Rack with IRIS connectors in the Rear

Use the supplied screws to attach the mounting brackets to the sides of the unit in the rear for mounting IRIS on a 19" rack. Your rack supplier usually supplies the screws required for mounting.

Mounting Flat on Wall

To mount the IRIS chassis for flat wall mount use the supplied rack mounting braces and attach them to the holes in the middle of chassis using the same screws.

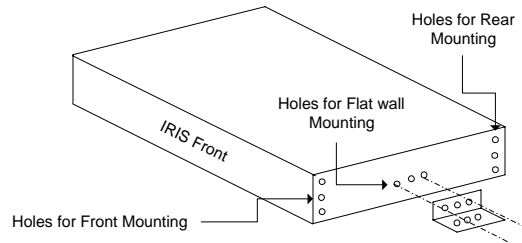


Figure 3 Attaching mounting braces for flat wall mount

You will need appropriate screws to secure the chassis to the wall. If you have a dry wall, recommended screws are hollow wall anchor screws. Always check your local code for compliance. Refer to the diagram for positioning the chassis so that sufficient air can flow in and out of the chassis.

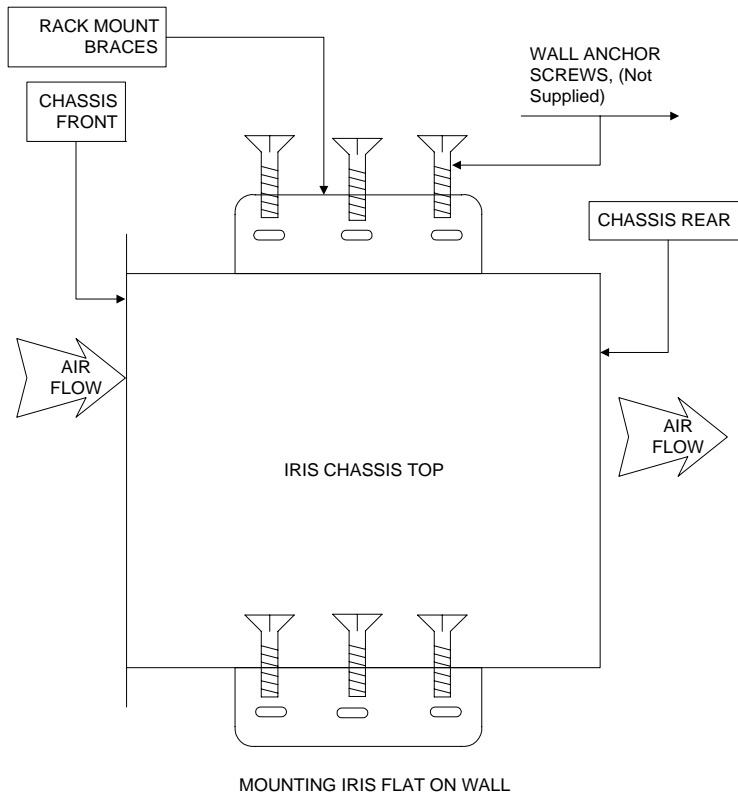


Figure 4 Flat Wall Mount

Do not mount the chassis with the chassis front of rear facing upwards. Falling debris from the ceiling can damage the systems fans. Make sure you have sufficient room around the air ducts for

air to flow in and out of the system. Sufficient airflow will guarantee peak performance and longevity of the IRIS system.

Connecting Your IRIS DC1100

1. Place your IRIS DC1100 in a location where it will be well ventilated. Do not stack it with other devices or place it on carpet.
2. Connect your WAN equipment Ethernet port with CAT5 cross over cable to IRIS DC1100 Ethernet Port. If connecting to a hub or switch use a CAT5 straight through cable.
3. For coaxial connections determine the model number of the IRIS unit.

The following models come with integrated fully agile 256 QAM DOCSIS Upconverter.

DC1100/DC1200/DC1400

The following models do not include an integrated upconverter.

DC1100X/DC1200X/DC1400X

You will have to connect the IF out from IRIS to a 256 QAM DOCSIS upconverter, before cable modems will be able to connect to IRIS.

Refer to the chapter 3 for diagrams detailing these connections.

Checking Conditions Prior to System Startup

Check the following conditions before you start your gateway:

- All network interface cables are connected.
- The power cable is connected and secured.
- The console terminal is connected and powered on.

Starting the System

After installing the IRIS gateway and connecting cables, start the router as follows:

- Insert the power cable at the rear of the IRIS chassis. The green Power LED on the rear panel will light up.
- Listen for the fans; you should immediately hear them operating.

Configuring Your IRISDC1100

Coaxial Cable Specifications

The coaxial cable used to connect the IRIS DC1100 series universal broadband routers at the Headend should be very high-quality cable. Coaxial recommends that you use a Headend-grade coaxial cable or a quad-shield coaxial cable with a minimum of 60% + 40% braid and double foil insulation to connect the cable modem cards to the HFC network. The center conductor must be straight and extend 1/8 inch (3.2 mm) beyond the end of the connector, and the connector should be securely crimped to the cable. The following cables are recommended:

- RG-6 — Standard 75 Ohm
- RG-6/U — Dual or Quad Shielded 75 Ohm

Note

The consistent use of RG-6 or RG-6/U cable is preferred to connect the cable interface to the HFC network. If you connect an RG-6 cable to a cable interface that was previously connected using RG-6 cable, the difference in the center connector diameter might cause intermittent connectivity loss. If you use different types of coaxial cable, the following problems can appear:

- Co-channel interference—If signals at the same frequency are carried on long, parallel runs of coaxial cable, interference can occur between the signals. Higher quality cable helps to prevent this with better shielding. Co-channel interference is seen as hum or patterns in analog video channels and intermittent data loss in digital channels.
- Damage to the product —Cable interface card connectors are designed for RG-6 cable and connectors. Larger cables can damage the connectors.

Connections

Cable Network Diagram

IRIS Connections with Integrated Upconverter

IRIS model numbers DC1100 and DC1100C come with an integrated upconverter. The following diagram illustrates the connections.

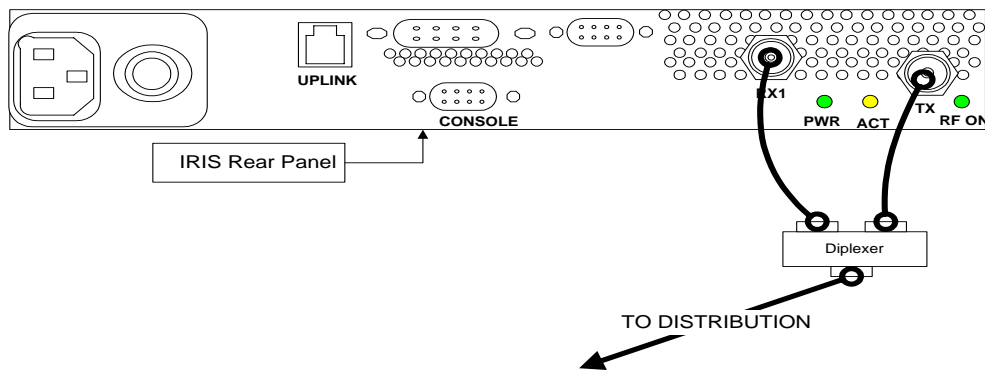


Figure 5 Connections with Integrated Upconverter



If in your headend you are using passive equipment such as combiner which does not allow return signals, make sure that the connections are made in such a manner that return signals are not affected by such equipment.

IRIS Connections with an external Upconverter

IRIS model numbers DC1100X and DC1100CX come without an integrated upconverter. You will need an external DOCSIS upconverter to connect IRIS to your cable system. The following diagram illustrates the connections when using IRIS with an external upconverter.

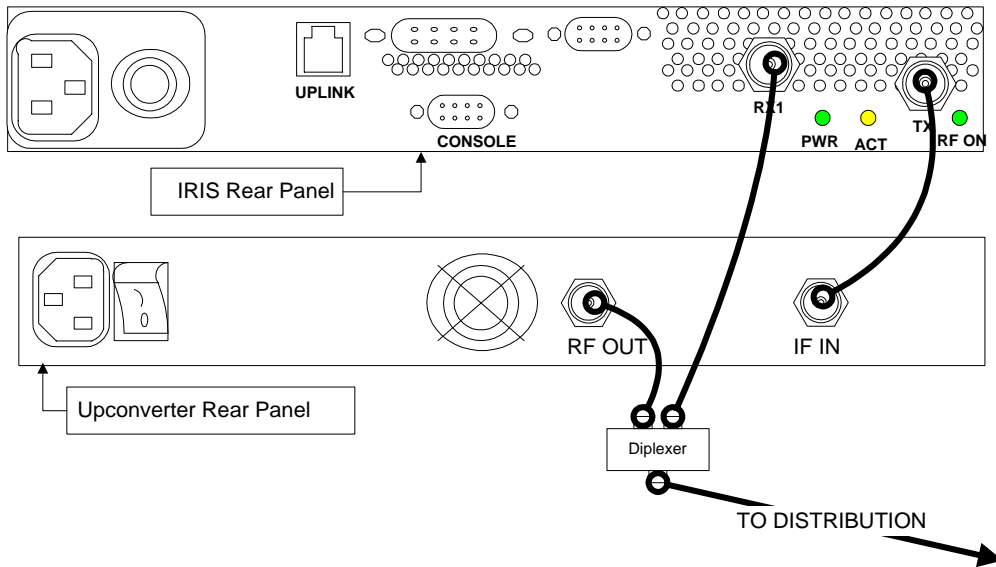


Figure 6 Connections with an external Upconverter

IRIS Uplink Connection

IRIS Uplink port is a 10/100 Ethernet port, which has to be connected to back office network switch or the uplink device such as satellite or DSL modem. When connecting to a switch a straight Cat5 Ethernet cable will be required. When connecting to a DSL modem or satellite modem you might need to use an orange colored cross over cable.

The link light on the IRIS Uplink port will light up when you have used the right cable required to connect to the switch or the uplink device.

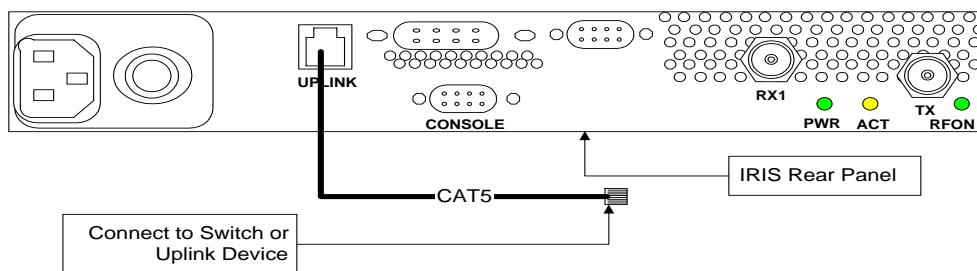


Figure 7 IRIS Uplink Connection

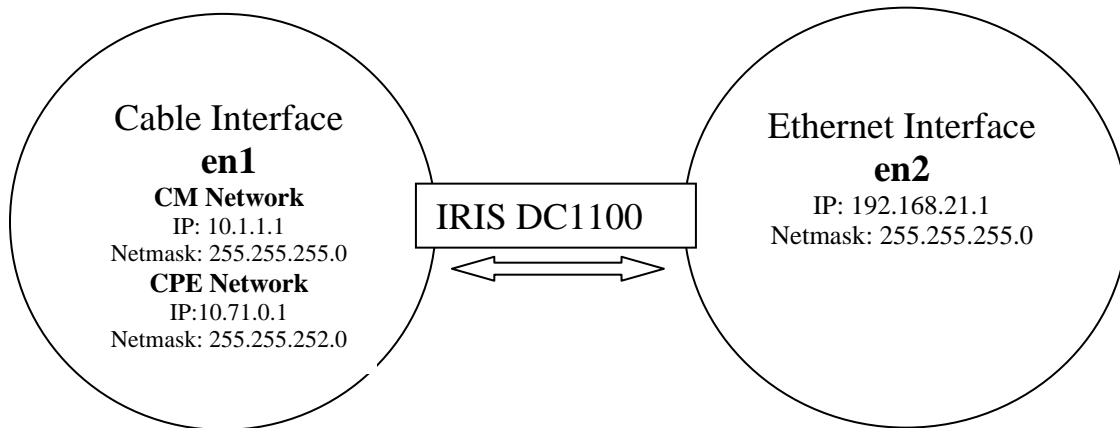
Configuration

Configuring IRIS

All IRIS systems can operate in Bridge or Routing mode with NAT enabled on the cable interface. At the time of shipping the system IRIS is configured to work in the routing mode with NAT enabled on the cable interface.

When NAT is enabled IRIS routes packets from its cable interface to the Ethernet interface and vice-versa. The diagram below represents the IP network topology with such configuration.

The cable interface is defined as “en1” interface and the Ethernet interface is defined as “en2”



Logging into IRIS

To configure IRIS you will have to login to IRIS either using the serial console port or over the network using the web interface or telnet program.

Connecting from Ethernet interface

You should have already connected the IRIS uplink Ethernet interface to a switch or to a PC using a cross over Ethernet cable. Configure your PC to have static IP address such as 192.168.21.100 and subnet mask 255.255.255.0. Make sure no other device on this network has this IP address.


Connecting using Web Interface

Start your Internet browser and point it to <http://192.168.21.1:2380>. You will be prompted by the “IRIS Admin” login window. Please enter the User name and Password to authenticate. All IRIS systems ship with default user name “iris” and password “123456”. IRIS Setup home page will appear in your browser as shown in Figure 9.



Figure 8 Web Login

Address http://192.168.21.1:2380/

IRIS Configuration and Management

Home	IRIS Node Name :	IRISDC1100
Basic Setup	IRIS Mode :	router
Network	IRIS Location :	Santa Clara
Change Password	Cable CM Interface	
Advanced Setup	IP address :	10.1.1.1
CM Subscription	Netmask :	255.255.255.0
CM Configuration	Cable CPE Interface	
RF Setup	IP address :	10.71.0.1
Downstream	Netmask :	255.255.252.0
Upstream	Uplink Interface	
CM Status	IP address :	192.168.21.1
Reboot	Netmask :	255.255.255.0
	Gateway :	192.168.21.254
	Nameserver	
	DNS Server :	192.168.21.254
	DNS Server :	192.168.21.254
	Domain name :	coaxialnetworks.com
	Servers	
	DHCP server :	Enabled
	NAT server :	Enabled
	Firewall :	Disabled
	Logs :	Disabled
	SNMP :	Disabled
	WEB server :	Enabled

Figure 9 Setup home page

The Web interface can be used to configure the following parameters

1. TCP/IP parameters
2. IRIS Operational mode
3. Web login password
4. Cable modem subscription
5. Cable modem tftp configuration file generation for QOS
6. Downstream channel, QAM mode and Output power level
7. Upstream frequency for each channel
8. Report cable modem status

Configuring TCP/IP parameters

To configure TCP/IP parameter for IRIS or to set its operational mode click on the “**Network**” on the left hand side navigational menu. Once selected the IRIS Network Setup screen appears on the right hand side as shown in Figure 10.

The screenshot shows a web browser window with the address bar displaying 'http://192.168.21.1:2380/'. The main content area is titled 'IRIS Configuration and Management' and features a dark blue sidebar on the left with a navigation menu. The menu items are: Home, Basic Setup, **Network** (highlighted in yellow), Change Password, Advanced Setup, CM Subscription, CM Configuration, RF Setup, Downstream, Upstream, CM Status, and Reboot. The main content area is divided into several sections for configuration:

- Network Setup**
 - Basic**
 - IRIS Node Name: IRISDC1100
 - IRIS Mode: router (dropdown menu)
 - IRIS Location: Santa Clara
 - Cable CM Interface**
 - IP address: 10.1.1.1
 - Netmask: 255.255.255.0
 - Cable CPE Interface**
 - IP address: 10.71.0.1
 - Netmask: 255.255.252.0
 - Uplink Interface**
 - IP address: 192.168.21.1
 - Netmask: 255.255.255.0
 - Gateway: 192.168.21.254
 - Nameserver**
 - DNS Server: 192.168.21.254
 - DNS Server: 192.168.21.254
 - Domain name: coaxialnetworks.com
 - Servers on IRIS**
 - Enable DHCP
 - Enable Logs
 - Enable WEB server
 - Enable NAT
 - Enable Firewall
 - Enable SNMP

At the bottom of the configuration area, there are three buttons: 'Save', 'Revert to factory settings', and 'Reset'.

Figure 10 IRIS Configuration Page

Configuring IRIS in Router mode

All IRIS systems ship with operational mode set to “router”. In router mode the cable interface is configured with a private interface and all cabled modems and CPEs attached to the cable modems are automatically assigned IP addresses from this private addressing scheme.

You will need to configure the “Uplink Interface” or the Ethernet Interface with the ISP provided configuration parameters. For the “Uplink Interface” enter the following

- IP address
- Netmask
- Gateway
- DNS Server
- Domain Name



Do not change the “Cable CM Interface” or the “Cable CPE Interface” address. Changing this will require you to edit the DHCP server configuration file manually. You should change this address only if you wish to do so and know how to manually program a dhcpd.conf file. Future releases of IRIS firmware will provide graphical user interface to edit the DHCP server configuration files.

After entering these, click the “Save” button. For changes to take effect select ‘Reboot’ from the left hand side navigation bar.



Figure 11 Save and reboot

Confirm the reboot with selecting the “Reboot” button. After the reboot you should be able to reach the “**uplink**” port of IRIS using the new IP address.

Configuring IRIS in Bridge mode

To configure IRIS in “bridge” mode select “**Network**” from the navigation menu bar. If you configure IRIS in bridge mode, you will need to use an external provisioning server that can provide all the required server functionality which includes DHCP server, TFTP server and TOD server.

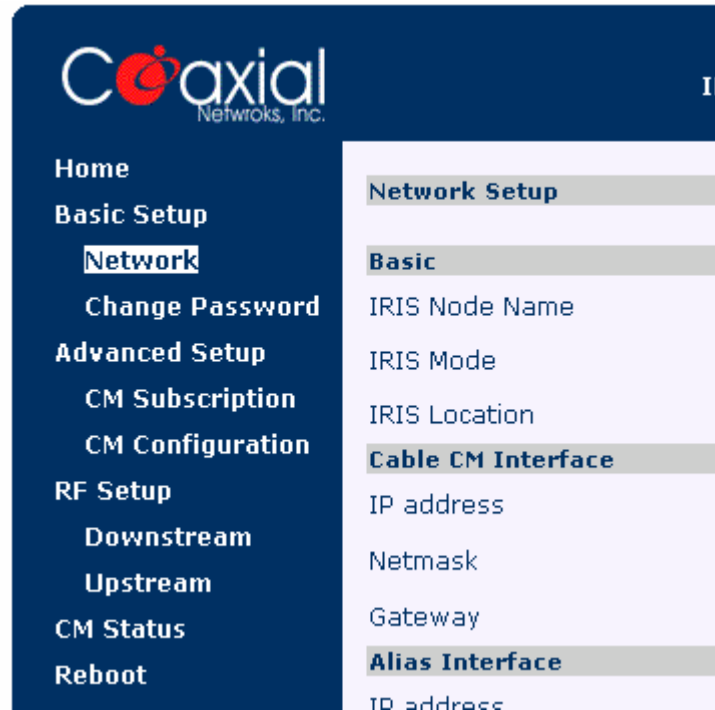


Figure 12 Network Setup

You will also need to configure your provisioning server so that it can allocate IP addresses to CPE devices that are behind the cable modems. CNI provides a provisioning server called ‘XFIRE’ to achieve this functionality.

If you are planning to use multiple IRIS in your cable plant you should put IRIS in bridge mode and use an external provisioning server. **The detail setup of such a provisioning server is beyond the scope of this document. Customers should contact CNI professional services to get further information and training on such topics.**

Click the “IRIS Mode” drop down box to select “bridge”

The screenshot shows the Coaxial Networks IRIS Configuration and Management web interface. The left sidebar contains a navigation menu with the following items: Home, Basic Setup (Network, Change Password), Advanced Setup (CM Subscription, CM Configuration), RF Setup (Downstream, Upstream), CM Status, and Reboot. The main content area is titled "Network Setup" and is divided into three sections: "Basic", "Cable CM Interface", and "Alias Interface".

Network Setup	
Basic	
IRIS Node Name	IRISDC1100
IRIS Mode	bridge
IRIS Location	bridge
	router
Cable CM Interface	
IP address	10.1.1.1
Netmask	255.255.255.0
Gateway	
Alias Interface	
IP address	
Netmask	
Gateway	

Figure 13 Bridge mode setup

This will change the IRIS Setup screen so that the system can be configured in the bridge mode. In bridge mode IRIS only has one interface, which is the “cable” interface. IRIS then forward all traffic from the HFC side to the Ethernet side.

If you are planning to use the DHCP server available on IRIS do not change “Cable CM Interface” address. If you change this address and plan to use DHCP server on IRIS to assign IP addresses to the cable modems make sure that the DHCP configuration file has appropriately been updated.

Using the Alias Interface you can assign another IP address configuration to IRIS; this could be useful if you wish to assign a public IP address to IRIS.

The screenshot displays the 'IRIS Configuration and Management' web interface. On the left is a dark blue navigation menu with the following items: Home, Basic Setup, Network, Change Password, Advanced Setup, CM Subscription, CM Configuration, RF Setup, Downstream, Upstream, CM Status, and Reboot. The main content area is titled 'Network Setup' and contains several sections:

- Basic**: IRIS Node Name (IRISDC1100), IRIS Mode (bridge), IRIS Location (Santa Clara).
- Cable CM Interface**: IP address (10.1.1.1), Netmask (255.255.255.0), Gateway (empty).
- Alias Interface**: IP address (redacted), Netmask (redacted), Gateway (empty).
- Nameserver**: DNS Server (192.168.21.254), DNS Server (192.168.21.254), Domain name (coaxialnetworks.com).
- Servers on IRIS**:
 - Enable DHCP
 - Enable Logs
 - Enable WEB server
 - Enable NAT
 - Enable Firewall
 - Enable SNMP

At the bottom of the configuration area are three buttons: 'Save', 'Revert to factory settings', and 'Reset'.

Figure 14 Bridge Mode Configuration

Configuring Downstream RF Settings

DOCSIS protocol utilizes an available channel to send downstream signal for data communications. Depending upon the frequency plan NTSC or PAL, IRIS automatically provides you the channel number and the center frequency in a drop down menu.

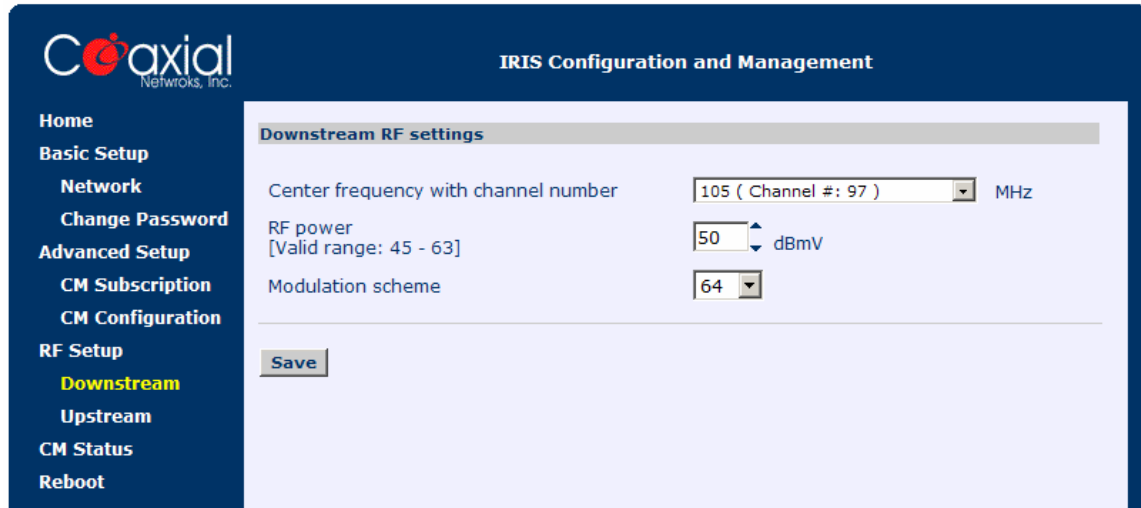


Figure 15 Downstream RF Settings

Using the “Center frequency with channel number” select the channel that you wish to use to send downstream signal. This channel should not be used to send any video signal.

Using the “RF Power” setting you can adjust the output level of the downstream signal. If you wish to adjust output power levels beyond the range you have to use outside attenuators. Digitally modulated signal levels are usually 10 to 12 dB less than the analog signal levels for the adjacent carriers.

256 and 64 QAM modulation is used for downstream communication. 256 QAM requires a much cleaner plant and channel. For noisier cable plants it is recommended to use 64 QAM for downstream. Using the ‘Modulation scheme’ select the appropriate downstream modulation plan.

After making the selection click the “Save” button to apply these changes. Center frequency and RF power changes do not require system to be rebooted. Changing the downstream modulation scheme requires a system restart.

Configuring Upstream RF Settings

DOCSIS protocol utilizes a separate upstream frequency to provide upstream data communication back from the cable modem. Your cable plant has to be two way ready or return passing to provide high speed data communication over cable. The North American plan uses up to a 3.2MHz wide channel in the 5-42MHz frequency range. The European plan uses up to a 3.2 MHz wide channel in the 5-65MHz frequency range. For upstream communications DOCSIS provide QPSK or 16QAM modulation schemes. QPSK modulation profiles are much tolerant to noise. 16QAM modulation profiles require very clean cable plants and signal to noise ratios.

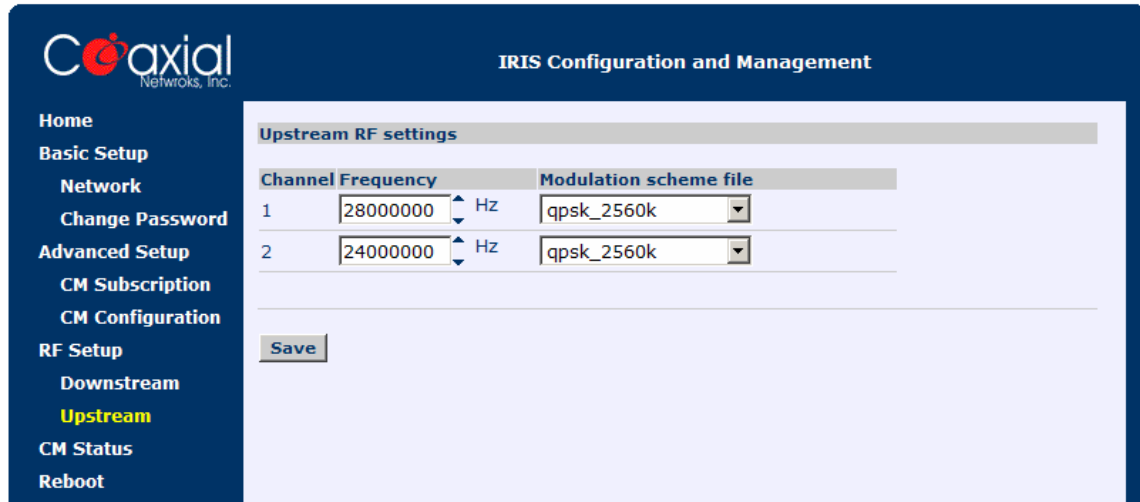


Figure 16 Upstream RF Settings

Depending upon the IRIS model you have, the Upstream RF Settings screen will have the number of channels. For a DC1100 the screen will only have Channel 1, for DC1200 the screen will show Channel 1 and Channel 2.

In the Frequency section for each channel type in the desired upstream center frequency you wish to use. From the available modulation profiles select the modulation profile you wish to use. Various modulation profiles for both 16QAM and QPSK are provided in the system.

If your system has more than one upstream channel make sure that there frequency values are separated by a sufficient buffer or else they will interfere with each other resulting in loss of cable modems.

After you have made the right selection, click on "Save" and the changes will apply after the system is restarted.

Creating Class of Service Profiles

DOCSIS based data networks allow each cable modem to be associated to a class of service. This class of service configuration is downloaded by the cable modem during registration process using TFTP protocol.

IRIS provides a user interface using which you can enter different values for a cable modem configuration file and then save these settings to class of service. These classes of services profiles are then available to you in the “CM Subscription” section of IRIS configuration.

Home
Basic Setup
 Network
 Change Password
Advanced Setup
 CM Subscription
 CM Configuration
RF Setup
 Downstream
 Upstream
CM Status
Reboot

Cable Modem Configuration File Generator

Cable Modem Configuration Settings

DS Frequency NA-DOCSIS E-DOCSIS
NA-DOCSIS Frequency 0 (Channel #: 0) [v]
E-DOCSIS Frequency 0 [v]
US Channel ID 1 [v]
Net Access Enable Enable Disable

Class of Service Request

SVC Class ID []
Max DS Rate Bits per second []
Max US Rate Bits per second []
US Priority []
Guaranteed US Rate Bits per Second []
Configuration File Name []

Optional Settings

Maximum CPE per Cable Modem 1 [v]

Generate Config file **Reset**

Figure 17 Class of Service Creation

When creating cable modem configuration files which specify the class of service that the cable modem and CPEs behind them will be receiving, you can specify a different downstream channel that the cable modem should resynchronize to after registering with this IRIS. You can also specify which upstream channel a cable modem should register on. The Upstream channel can be used to tie a particular class of service to a particular upstream channel. This setting is useful if you have IRIS DC1200 or IRIS DC1400 models.

The “**Net Access Enable**” setting specifies if CPEs behind a cable modem configuration that downloads this configuration file will be able to get access o the network or not.

The remaining settings specify the various parameters for class of service. Chose a “**SVC Class ID**” by which you want to identify this service. This value can be any integer value and is used for identification purposes only.

In the “**MAX DS Rate...**” specify the rate at which cable modems can download data. For example if you wish to provide a 512bps data rate, you would enter 512000 in this field.

In the “**US Priority**” specify the priority that you wish to assign traffic coming from this cable modem in the upstream direction. IRIS supports 1 to 7 upstream priority classifications, 1 being the highest.

In the “**Guaranteed US Rate**” specify upstream data rate which you wish to guarantee for each cable modem. For example for voice traffic a guaranteed upstream rate of 64000 is recommended.

In the “**Configuration File name**” specify the name you would wish to give this type service, for example “business” or “residential”.

In the “**Maximum CPE per Cable Modem**” select the number of CPEs you wish to allow behind the cable modem.

After entering all the values, make sure that these are the settings you wish to create this class of service with and then click the “**Generate Configuration file**”

Remember that any protocol has overhead and your customers will see slightly less value if they do a speed test. Usually the speed test program does not account for the overhead of transferring IP packets.

In the “**MAX US Rate...**” specify the rate at which cable modems can upload data. For example if you wish to provide a 128Kbps data rate, you would enter 128000 in this field.

IRIS implements a Class Based Queue and Round Robin allocation strategies for downstream rate regulation. In Round Robin packets are put on a first in first out queue and as long as bandwidth is available it will be given to the client requesting it.

If you wish to rate limit a customer to the bandwidth he is subscribed for even though there is bandwidth available you have to enable the Class Based Queuing. By default round robin is enabled.

Controlling Cable Modem Access

IRIS can allow all or selectively allow cable modems connected to your cable network to gain access to the Internet.

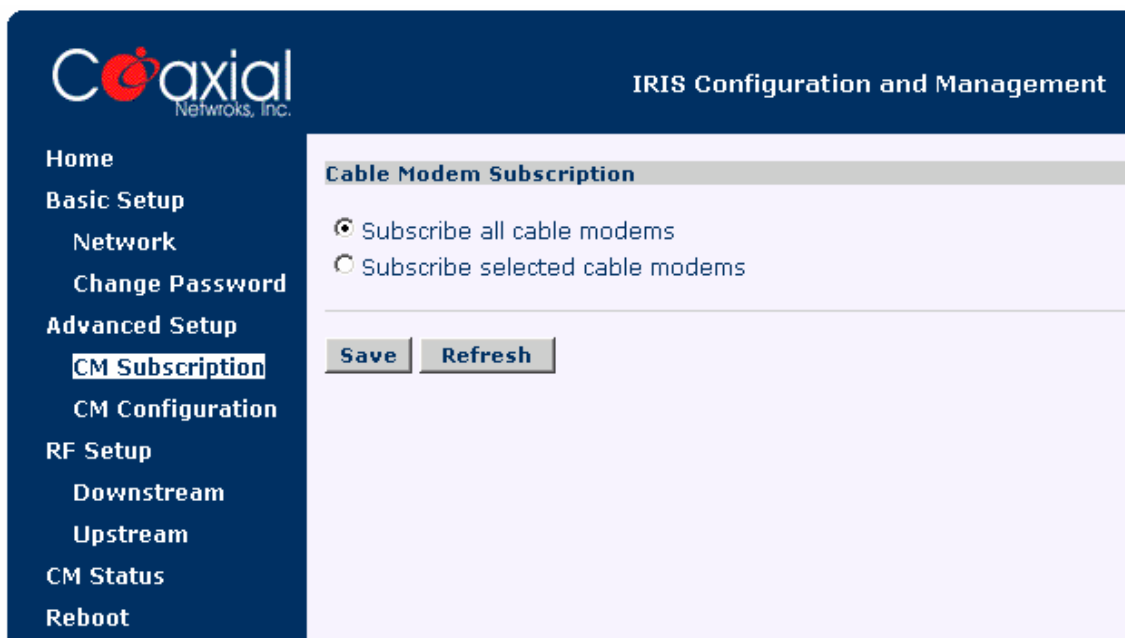


By default IRIS is configured such that all modems that are connected on your cable plant can gain access to the Internet.

To enable conditional access to certain we need to enable conditional access and then add the MAC addresses of the cable modems. Once it has been done only cable modems with these MAC addresses can register with IRIS. Other cable modems will not register and PCs behind these cable modems will not be able to connect to the Internet.

Enabling conditional access

Using your browser connect to IRIS configuration interface. Select “CM Subscription” under Advanced options.



To enable conditional access to the modems select the “Subscribe selected cable modems” and then select “Save”. This change comes into effect after you restart IRIS.

Adding Cable Modems

After you have enabled conditional access for cable modems and restarted the system, you should see the list of cable modems that have been subscribed. All remaining modems that have not been subscribed but have tried to connect to the IRIS will show up in the “unsubscribed modems” list.

You can move cable modems that show up in the “unsubscribed modems” list to the “subscribed modems” list. While subscribing modems you can assign a unit number that can be used to define

the location of each cable modem and also associate the cable modem to one of the class of service profiles you have created. If you have not created any class of service profiles, create a class of service using the “CM configuration” option.

A cable modem that had yet not been connected to the cable network will not show up in the “unsubscribed modems” list. If you wish to subscribe such a cable modem before it is connected to the cable network you should use the ‘Quick Subscription’ option to enter the Mac address of the cable modem in the show format manually and click on the “Subscribe” button.

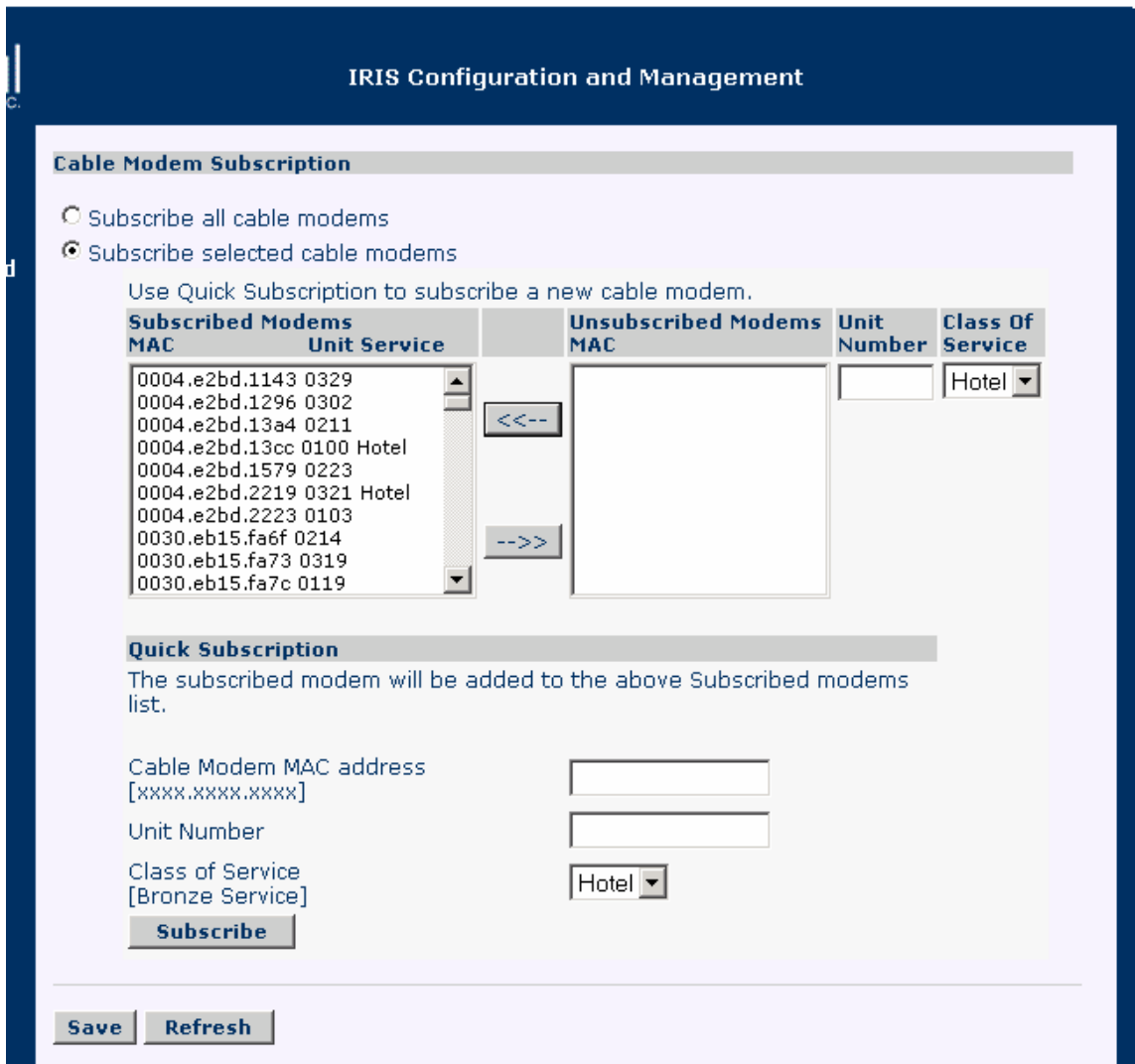


Figure 18 Cable Modem Subscription

Saving Cable Modems List

After each subscription please click the “Save” button so that the cable modem configuration is updated correctly in the system.

You will need to save the “subscribed modems” list so that the same is available after a system restart. Press the “Save” button to save or update the “subscribed modems” list to the flash memory of IRIS.

IRIS CLI interface using Telnet

IRIS also provides a CLI interface for certain advanced configuration and diagnostics. You will need a PC to connect using telnet. You should be able to connect to IRIS from the HFC side if you have successfully been able to bring up a cable modem. The easiest way to connect to IRIS is from the Ethernet interface of IRIS.

Connecting from the cable interface

If you have connected a cable modem to the cable network you can connect to IRIS using a PC connected to the cable modem. Make sure the cable modem's "cable" LED is steady which indicates that the cable modem is configured correctly and is up and running. If the "cable" LED is either off or still blinking the cable modem is not up yet, use the "Connecting from Ethernet interface" or "Connecting using serial console" methods.

Set your PC's Ethernet interface to be configured using dynamic host control protocol or DHCP. As soon as your PC is connected to the Ethernet port of the cable modem it will be assigned an IP address with the "10.71.0.X" domain.

Telnet to IRIS

You can now telnet from Windows Start Menu/Run option by typing "telnet 10.71.0.1" and selecting OK button. You will be greeted with the following messages and a "login" prompt in the telnet window.

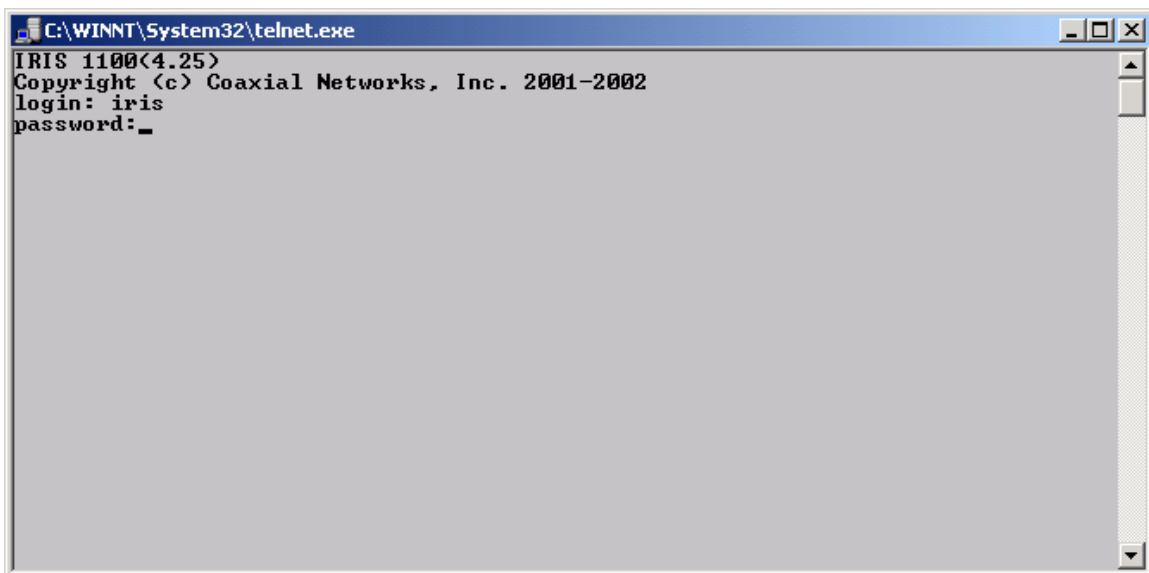


Figure 19 Telnet login prompt

Connecting from serial console

Using a serial (RS232) 9 pin null modem cable connect your PC's serial port to the serial console port of IRIS. Now you can use tools such as "HyperTerminal" in Windows to connect to IRIS. The settings for the serial console port of IRIS are

Baud Rate: 57600
Data Bits: 8
Parity: None
Stop Bits: 1
Flow Control: None

After successfully connecting to the console port you should see the IRIS "login" prompt.

Logging In

At the login prompt, type the username as "iris" and hit enter. At the "password" prompt type "123456" or the new password if you have already changed the default password.

After you have successfully logged in you are greeted by the "IRIS>" prompt.

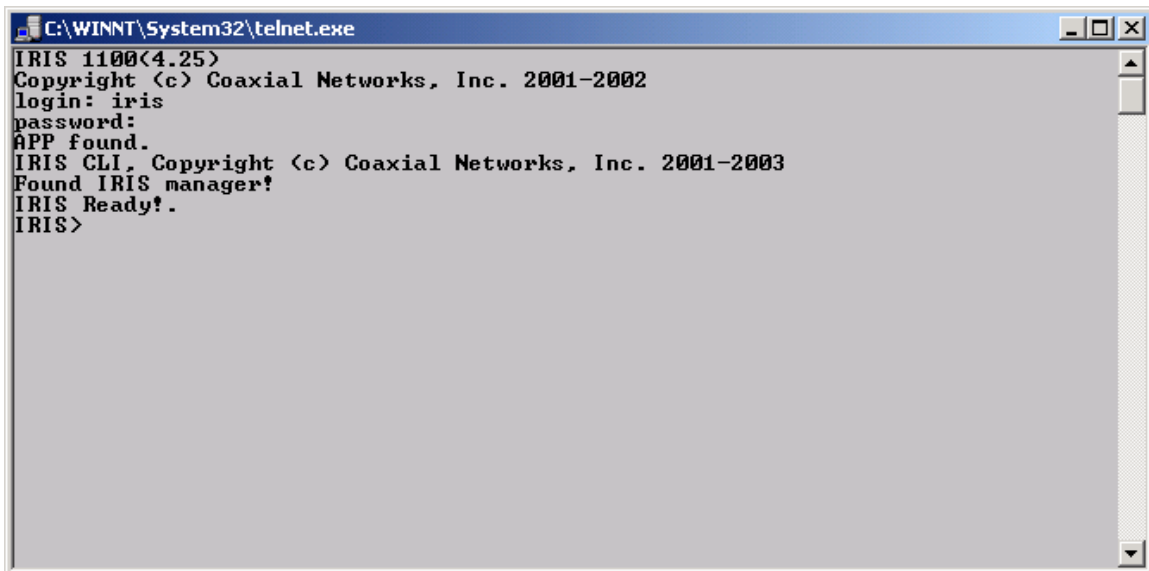


Figure 20 IRIS CLI prompt

"help" command

You can type "?" or "help" on the IRIS prompt to see the list of CLI commands available.

You can type "?" or "help" on the IRIS prompt to see the list of CLI commands available.

```
IRIS>?  
  
(h)elp ..... list usage  
count ..... print packet counters  
rcount ..... clear packet counters  
ver ..... display IRIS version
```

```

psid..... print MacAddress to Sid map
preg..... print CM registration status
pcpe..... print CM and associated CPE
config_cm <ifile> <ofile> ..... generate CM config file
(q)uit ..... quit command interpreter
system ..... go to the system prompt
reboot ..... restart the system
shutdown ..... shutdown the system
!..... repeat last command
tty..... displays the terminal name
passwd..... changes password for iris
upcon <cmd> ..... upconverter config command, upcon ? for list
setupl ..... setup uplink (en2) IP network parameters
setif <if> <ip> <netmask> ..... sets interface ip address and netmask
showif [if] ..... show interface parameters, en1, en2
dhcp <cmd> ..... dhcp server command, dhcp ? for list
bridge [on/off] ..... Enable or disable bridging mode for IRIS
addcm <mac_address> [comment] .. Add CM to subscribed list
delcm <mac_address> ..... Delete CM from subscribed list
savecm ..... Save subscribed CM list
psub ..... Print subscribed CM list
punsub ..... Print unsubscribed CM list

```

Figure 21 List of CLI commands

“preg” or “preg verbose” command

The “preg” command displays you a list of MAC addresses of cable modems that have communicated to IRIS, their SID (service identifier) and the current registered state.

```

IRIS>preg

Registered CMs
-----
MAC                PSID      USID      STATUS
-----
00:0b:06:9f:a7:fe  0x0002    0x01      Yes
00:10:95:1b:e1:c5  0x0001    0x01      Yes
00:30:eb:bc:0c:a5  0x0004    0x01      Yes
00:90:83:8c:58:23  0x0003    0x01      Yes
00:e0:ca:00:c1:9c  0x0005    0x01      Yes

Total(5), Yes(5) No(0)

Unsubscribed CMs
-----

Total(0)

```

Figure 22 List of registered cable modems

“psid” command

The “psid” command displays you a list of MAC addresses of cable modems or PCs connected to the cable modems. Each cable modem and PCs connected to them will have unique MAC address but same SID or service identifier.

```

IRIS>psid

MAC address to SID map:
-----
MAC                SID

```

```

-----
00:0b:00:02:01:0a  0x0002
00:0b:06:9f:a7:fe  0x0002
00:10:5a:d0:1d:cd  0x0001
00:10:95:1b:e1:c5  0x0001
00:10:b5:3e:56:a2  0x0002
00:30:eb:bc:0c:a5  0x0004
00:90:83:8c:58:23  0x0003
00:e0:ca:00:c1:9c  0x0005
ff:ff:ff:ff:ff:ff  0x16383

```

Total: (9)

Figure 23 List of SID and their MAC addresses

“pcpe” command

The “pcpe” command displays you a list of MAC addresses of cable modems that have communicated to IRIS, their SID (service identifier) and the current registered state. It also displays the MAC addresses of the CPE’s connected to each registers cable modems.

```

IRIS>pcpe

Registered CMs
-----
MAC                PSID      USID      STATUS
-----
00:0b:06:9f:a7:fe  0x0002    0x01      Yes
00:0b:00:02:01:0a
00:10:b5:3e:56:a2
00:10:95:1b:e1:c5  0x0001    0x01      Yes
00:10:5a:d0:1d:cd
00:30:eb:bc:0c:a5  0x0004    0x01      Yes
00:90:83:8c:58:23  0x0003    0x01      Yes
00:e0:ca:00:c1:9c  0x0005    0x01      Yes

Total(5), Yes(5) No(0)

Unsubscribed CMs
-----

Total(0)

```

Figure 24 List of CPEs connected to the CMs

“config_cm” command

The “config_cm” is used to compile and create cable modem configuration file that the cable modems download from IRIS during the registration process. The cable modem configuration file has important operational parameters including the data rates that the cable modem will be using for upstream and downstream traffic.

The cable modem configuration files should be located in the “/tftpboot” directory after compilation and the “/etc/dhcpd.conf” specifies the name of the configuration file to the cable modem during it downloads IP parameters from the Dhcp server.

“count” command

The “count” command displays the number of Interrupts, Packets received, Packets Transmitted and Errors on the cable interface of IRIS.

“rcount” command

Resets the values of the above mentioned counters.

“ver” command

Displays the version of IRIS and IRIS CLI.

“reboot” command

Restarts the system.

“shutdown” command

Shuts down the system, so that it can be powered off safely.

“system” command

Takes you to the QNX system prompt from the IRIS CLI. To return back to the IRIS CLI, type “exit” at the system prompt.

“quit” command

The quit command exits the IRIS CLI. On a telnet connection it would close your telnet session. On the serial console, it will log out and display the login prompt gain.

“!” command

Repeats the last command that you had typed.

“tty” command

Displays the name of the terminal you are currently connected on.

“passwd” command

Prompts to change the “iris” password. You should change the “iris” password once you have received the system. Make a note of the password in a safe place so that you do not forget the password.

“upcon” command

Using the “upcon” command you can program and check status of the integrated upconverter in the IRIS DC1100 and IRIS DC1100C.

Upcon FL <frequency>

Load upconverter with the desired frequency, output is muted and then unmuted.

For example to set the downstream frequency to 369MHz, at the “IRIS>” prompt type

```
upcon fl 369000000
```

Consult chapter on “**Channel Frequency Chart**” to find center frequency of a TV channel that you wish to use.

Upcon FLI <frequency>

Loads upconverter with the desired frequency without affecting the output.

See the Upcon FL command for example.

Upcon AI <IF attenuator setting>

Load the desired value for the IF Attenuator. User should use the “IAE” and let the upconverter chose the desired attenuation automatically.

Upcon IAS <high limit> <low limit>

Set the IF IF ALC high and low limit

Upcon IAD

Disable IF ALC.

Upcon IAE

Enable IF ALC. This is the default setting and should not be changed.

Upcon ITS

IF Threshold Set

Upcon ITD

IF Threshold Disable

Upcon ITE

IF Threshold Enable

Upcon MOD

Disable upconverter output.

Upcon MOE

Enable upconverter output.

Upcon AR <number of 0.1dB steps>

Loads the RF Attenuator with desired value.

Upcon RAS <high limit> <low limit>
Sets high and low values for RF ALC.

Upcon RAD
Disable RF ALC.

Upcon RAE
Enable RF ALC. This is the default setting.

Upcon RLS <RF Power limit>
Sets the RF power limit.

Upcon RPS <RF Power level>
Sets the RF Power.

Upcon RTD
Disable the RF Threshold.

Upcon RTE
Enable the RF Threshold.

Upcon RTS <high limit> <low limit>

Sets the desired value for the RF Threshold.

Upcon SC
Displays the current operating parameters for the upconverter.

Upcon SP
Displaces the IF and RF power coming to and from the upconverter module.

This page intentionally left blank

Application Notes

Network traffic between cable clients

By default IRIS does not allow traffic between CPEs behind cable modems on the same IRIS. To enable this you have to turn the “NetLoopbackMode” setting in iris.txt file to “1”.

Edit the “iris.txt” file from the system prompt and then change the above setting to

```
NetLoopbackMode = 1
```

Save the file and restart IRIS.

Allowing PPPoE traffic across IRIS

By default IRIS is configured to forward Ethernet packets of IP protocol type only. If you wish to offer PPPoE services to your customers, you have to configure IRIS so that PPPoE protocol is forwarded across IRIS. This configuration applies if you are operating IRIS in bridge mode.

Edit the “iris.txt” file from the system prompt and then under the “BEGIN_NetProtocolType” section add the following lines which specify the PPPoE Ethernet packet type

```
BEGIN_NetProtocolType
TypeField1 = 0x81
TypeField2 = 0
TypeLength = 1
END_NetProtocolType
```

Make sure you do not remove the default forwarding for IP Ethernet packet types.

```
BEGIN_NetProtocolType
TypeField1 = 8 // default = 8 (IP)
TypeField2 = 0 // default = 0 (ALL)
TypeLength = 1 // default = 1
END_NetProtocolType
```

Save the file and restart IRIS.

Static IP Mapping

When IRIS is operating in Router mode, some ISPs will like to reserve a publicly routable IP address for a specific CPE behind the Network Address translation. Using this feature IRIS will then create a one to one mapping between the public IP address and the private IP address. This feature of NAT is called BIMAP.

To create a BIMAP you will need to know the MAC address of the CPE. To obtain this you can Telnet to IRIS and issue the "pcpe" command find the cable modem that the end user has, attached you will see his CPE Mac address.

Assigning a reserved IP address to the CPE.

Edit the /etc/dhcpd.conf file and add a "host" entry for the MAC address of the CPE with a Reserved IP address in the "#CPE Network" subnet

```
host user1 {
    hardware ethernet 00:12:17:4C:9b:21;
    fixed-address 10.71.0.2 ;
}
```

Save the file and restart the DHCP server using the following commands

```
# slay -f dhcpd <ENTER>
# dhcpd en1 <ENTER>
```

Assigning additional IP addresses to the uplink Interface

From system prompt edit the "netstart.user" file and add the following line

```
/usr/ucb/ifconfig en2 alias <ip-address> netmask <netmask>
```

Make sure you put the <ip-address> and <netmask> that you have from your service provider.

This command will configure IRIS "en2" or uplink interface with an additional IP address that will be used to create a BIMAP. Save the file and exit to system prompt.

Creating a BIMAP between the public IP address and the private IP address

From system prompt edit the startnat file and at the end of the line before the "EOF" command

```
bimap en2 <internal-ip-address>/32 -> <public-ip-address>/32
```

Replace <internal-ip-address> with the internal IP address that you have reserved in the dhcpd.conf file in step 1. Replace <public-ip-address> with the external Ip address that was assigned to the en2 port in step 2. Save the file and exit to system prompt. Restart the system to make the changes.

Channel Frequency Chart

NTSC Channel Frequency Chart in MHz (DOCSIS)

Channel Number	Bandwidth	Center Frequency
FM	88.0 - 108.0	
A-5 - 95	90.0 - 96.0	93.00
A-4 - 96	96.0 - 102.0	99.00
A-3 - 97	102.0 - 108.0	105.00
A-2 - 98	108.0 - 114.0	111.00
A-1 - 99	114.0 - 120.0	117.00
A - 14	120.0 - 126.0	123.00
B - 15	126.0 - 132.0	129.00
C - 16	132.0 - 138.0	135.00
D - 17	138.0 - 144.0	141.00
E - 18	144.0 - 150.0	147.00
F - 19	150.0 - 156.0	153.00
G - 20	156.0 - 162.0	159.00
H - 21	162.0 - 168.0	165.00
I - 22	168.0 - 174.0	171.00
7 - 7	174.0 - 180.0	177.00
8 - 8	180.0 - 186.0	183.00
9 - 9	186.0 - 192.0	189.00
10 - 10	192.0 - 198.0	195.00
11 - 11	198.0 - 204.0	201.00
12 - 12	204.0 - 210.0	207.00
13 - 13	210.0 - 216.0	213.00
J - 23	216.0 - 222.0	219.00
K - 24	222.0 - 228.0	225.00
L - 25	228.0 - 234.0	231.00
M - 26	234.0 - 240.0	237.00
N - 27	240.0 - 246.0	243.00
O - 28	246.0 - 252.0	249.00
P - 29	252.0 - 258.0	255.00
Q - 30	258.0 - 264.0	261.00
R - 31	264.0 - 270.0	267.00
S - 32	270.0 - 276.0	273.00
T - 33	276.0 - 282.0	279.00
U - 34	282.0 - 288.0	285.00

V - 35	288.0 - 294.0	291.00
W - 36	294.0 - 300.0	297.00
AA - 37	300.0 - 306.0	303.00
BB - 38	306.0 - 312.0	309.00
CC - 39	312.0 - 318.0	315.00
DD - 40	318.0 - 324.0	321.00
EE - 41	324.0 - 330.0	327.00
FF - 42	330.0 - 336.0	333.00
GG - 43	336.0 - 342.0	339.00
HH - 44	342.0 - 348.0	345.00
II - 45	348.0 - 354.0	351.00
JJ - 46	354.0 - 360.0	357.00
KK - 47	360.0 - 366.0	363.00
LL - 48	366.0 - 372.0	369.00
MM - 49	372.0 - 378.0	375.00
NN - 50	378.0 - 384.0	381.00
OO - 51	384.0 - 390.0	387.00
PP - 52	390.0 - 396.0	393.00
QQ - 53	396.0 - 402.0	399.00
RR - 54	402.0 - 408.0	405.00
SS - 55	408.0 - 414.0	411.00
TT - 56	414.0 - 420.0	417.00
UU - 57	420.0 - 426.0	423.00
VV - 58	426.0 - 432.0	429.00
WW - 59	432.0 - 438.0	435.00
XX - 60	438.0 - 444.0	441.00
YY - 61	444.0 - 450.0	447.00
ZZ - 62	450.0 - 456.0	453.00
AAA - 63	456.0 - 462.0	459.00
BBB - 64	462.0 - 468.0	465.00
CCC - 65	468.0 - 474.0	471.00
DDD - 66	474.0 - 480.0	477.00
EEE - 67	480.0 - 486.0	483.00
FFF - 68	486.0 - 492.0	489.00
GGG - 69	492.0 - 498.0	495.00
HHH - 70	498.0 - 504.0	501.00
III - 71	504.0 - 510.0	507.00
JJJ - 72	510.0 - 516.0	513.00
KKK - 73	516.0 - 522.0	519.00
LLL - 74	522.0 - 528.0	525.00
MMM - 75	528.0 - 534.0	531.00

NNN - 76	534.0 - 540.0	537.00
OOO - 77	540.0 - 546.0	543.00
PPP - 78	546.0 - 552.0	549.00
QQQ - 79	552.0 - 558.0	555.00
RRR - 80	558.0 - 564.0	561.00
SSS - 81	564.0 - 570.0	567.00
TTT - 82	570.0 - 576.0	573.00
UUU - 83	576.0 - 582.0	579.00
VVV - 84	582.0 - 588.0	585.00
WWW - 85	588.0 - 594.0	591.00
XXX 86	594.0 - 600.0	597.00
YYY - 87	600.0 - 606.0	603.00
ZZZ - 88	606.0 - 612.0	609.00
89 - 89	612.0 - 618.0	615.00
90 - 90	618.0 - 624.0	621.00
91 - 91	624.0 - 630.0	627.00
92 - 92	630.0 - 636.0	633.00
93 - 93	636.0 - 642.0	639.00
94 - 94	642.0 - 648.0	645.00
100 - 100	648.0 - 654.0	651.00
101 - 101	654.0 - 660.0	657.00
102 - 102	660.0 - 666.0	663.00
103 - 103	666.0 - 672.0	669.00
104 - 104	672.0 - 678.0	675.00
105 - 105	678.0 - 684.0	681.00
106 - 106	684.0 - 690.0	687.00
107 - 107	690.0 - 696.0	693.00
108 - 108	696.0 - 702.0	699.00
109 - 109	702.0 - 708.0	705.00
110 - 110	708.0 - 714.0	711.00
111 - 111	714.0 - 720.0	717.00
112 - 112	720.0 - 726.0	723.00
113 - 113	726.0 - 732.0	729.00
114 - 114	732.0 - 738.0	735.00
115 - 115	738.0 - 744.0	741.00
116 - 116	744.0 - 750.0	747.00
117 - 117	750.0 - 756.0	751.00
118 - 118	756.0 - 762.0	759.00
119 - 119	762.0 - 768.0	765.00
120 - 120	768.0 - 674.0	771.00
121 - 121	774.0 - 780.0	777.00

122 - 122	780.0 - 786.0	783.00
123 - 123	786.0 - 792.0	789.00
124 - 124	792.0 - 798.0	795.00
125 - 125	798.0 - 804.0	801.00
126 - 126	804.0 - 810.0	807.00
127 - 127	810.0 - 816.0	813.00
128 - 128	816.0 - 822.0	819.00
129 - 129	822.0 - 828.0	825.00
130 - 130	828.0 - 834.0	831.00
131 - 131	834.0 - 840.0	837.00
132 - 132	840.0 - 846.0	843.00
133 - 133	846.0 - 852.0	847.00

PAL Frequency Allocation (EuroDOCSIS)

System L France	System K1 France Overseas	System I RSA	System I Ireland	System D OIRT	System D PRC	Center Frequency
					6	171 MHz
	4	4		RV I		178 MHz
			ID		7	179 MHz
1						179.5 MHz
	5	5		RV II		186 MHz
			IE		8	187 MHz
2						187.75 MHz
	6	6		RV III		194 MHz
			IF		9	195 MHz
3						195.75 MHz
	7	7		RI X		202 MHz
			IG		10	203 MHz
4						203.75 MHz
	8	8		RX		210 MHz
			IH		11	211 MHz
5						211.75 MHz
	9	9		RX I		218 MHz
			U		12	219 MHz
6						219.75 MHz
		10		RX II		226 MHz
					13	227 MHz
		11				234 MHz
		13				250 MHz

Table 1 Channel Center Frequencies for Selected PAL Systems

System G - Hyperband	Channel Center Frequency
S 21	306 MHz
S 22	314 MHz
S 23	322 MHz
S 24	330 MHz
S 25	338 MHz
S 26	346 MHz
S 27	3564 MHz
S 28	362 MHz
S 29	370 MHz
S 30	378 MHz
S 31	386 MHz
S 32	394 MHz
S 33	402 MHz
S 34	410 MHz
S 35	418 MHz
S 36	426 MHz
S 37	434 MHz
S 38	442 MHz
S 39	450 MHz
S 40	458 MHz
S 41	466 MHz

Table 2 Channel Center Frequencies for System G – Hyperband

System G UHF Europe	System D UHF PRC	Channel Center Frequency
Channel 21	Channel 13	474 MHz
Channel 22	Channel 14	482 MHz
Channel 23	Channel 15	490 MHz
Channel 24	Channel 16	498 MHz
Channel 25	Channel 17	506 MHz
Channel 26	Channel 18	514 MHz
Channel 27	Channel 19	522 MHz
Channel 28	Channel 20	530 MHz
Channel 29	Channel 21	538 MHz
Channel 30	Channel 22	546 MHz
Channel 31	Channel 23	554 MHz
Channel 32	Channel 24	562 MHz
Channel 33		570 MHz
Channel 34		578 MHz
Channel 35		586 MHz
Channel 36		594 MHz
Channel 37		602 MHz
Channel 38	Channel 25	610 MHz
Channel 39	Channel 26	618 MHz
Channel 40	Channel 27	626 MHz
Channel 41	Channel 28	634 MHz
Channel 42	Channel 29	642 MHz
Channel 43	Channel 30	650 MHz
Channel 44	Channel 31	658 MHz
Channel 45	Channel 32	666 MHz
Channel 46	Channel 33	674 MHz
Channel 47	Channel 34	682 MHz
Channel 48	Channel 35	690 MHz
Channel 49	Channel 36	698 MHz
Channel 50	Channel 37	706 MHz
Channel 51	Channel 38	714 MHz
Channel 52	Channel 39	722 MHz
Channel 53	Channel 40	730 MHz
Channel 54	Channel 41	738 MHz
Channel 55	Channel 42	746 MHz
Channel 56	Channel 43	754 MHz
Channel 57	Channel 44	762 MHz
Channel 58	Channel 45	770 MHz
Channel 59	Channel 46	778 MHz
Channel 60	Channel 47	786 MHz
Channel 61	Channel 48	794 MHz
Channel 62	Channel 49	802 MHz
Channel 63	Channel 50	810 MHz
Channel 64	Channel 51	818 MHz
Channel 65	Channel 52	826 MHz
Channel 66	Channel 53	834 MHz
Channel 67	Channel 54	842 MHz
Channel 68	Channel 55	850 MHz
Channel 69	Channel 56	858 MHz



	Channel 57	866 MHz
	Channel 58	874 MHz
	Channel 59	882 MHz
	Channel 60	890 MHz
	Channel 61	898 MHz
	Channel 62	906 MHz

Table 3 Channel Center Frequencies for System G and D

Regulatory Compliance

Agency Standards

The IRIS system complies with the following standards and agency requirements:

- Compliance Marking: CE, FCC
- Safety : EN60950
- EMC Emissions: EN55022A:CISPR:1993
- EMC Immunity: EN55024 – 1998 Standard; EN61000-4-2; EN61000-4-3, EN61000-4-4; EN61000-4-5; EN61000-4-6; EN61000-4-8; EN61000-4-11:1994; EN61000-3-2; EN61000-3-3

Specifications

Physical:	<ul style="list-style-type: none"> • Form Factor 1U “Pizza Box” • Height 1.75 in / 4.45 cm • Width 17.5 in / 44.4 cm • Depth 12 in / 30.5 cm • Weight 10 lbs / 4.5 Kgs
Mounting:	<ul style="list-style-type: none"> • Front Rack Mount • Rear Rack Mount • Flat Wall Mount
Temperature	32-104° F (0-40° C) operating -4-149° F (-20-65° C) non operating
Console port	Asynchronous serial (DB9)
Humidity	10 to 90% non-condensing
Network Side Interface:	<ul style="list-style-type: none"> • 1 Fast Ethernet Port, 10/100Mbps
RF Spectrum Support:	<ul style="list-style-type: none"> • 1 Downstream channel • Downstream modulation 64QAM and 256 QAM • Downstream per channel bit rate 30 Mbps (64QAM) and 40 Mbps (256 QAM) • Downstream Frequency Range 88MHz-850MHz • Downstream Channel Spacing 6MHz/8MHz • 1 Upstream channel • Upstream Modulation QPSK and 16 QAM • Upstream per channel bit rate 0.320 – 10.24 Mbps • Upstream Frequency Range 5MHz-42MHz/5MHz-65MHz Euro
Network Management & Provisioning:	<ul style="list-style-type: none"> • SNMP v1 and V3 • IETF MIBS • Coaxial MIBS • QNX 4.25 Real-time OS
Bridging & Routing:	<ul style="list-style-type: none"> • Layer2 Bridging, Routing • Network Address Translation • Firewall • RIP v1 and v2 • DOCSIS 1.0 and 1.1 (software upgradeable) • DHCP based IP address management
Provisioning:	<ul style="list-style-type: none"> • Integrated Auto Provisioning system
Compliance Marking :	<ul style="list-style-type: none"> • CE, FCC(Part 15 of the FCC)

VI (Visual) Editor

The *vi* is a text editor. It is small, powerful, and standard on most UNIX systems. The *vi* often frustrates new users with a unique distinction between its two modes: *Command Mode* and *Insert/Overtyping Mode*. This distinction, although difficult to become accustomed to for many users, provides great power and ability to the editor. Insert/Overtyping Mode is designed for inserting text only. All text manipulations and cursor moving should be done from within Command Mode.

Entering the *vi*

```
# vi
# vi file1 file2 ...
# vi -r file #Recover file from crash
# vi +string file #Execute ex command "string"
# vi @rcfile #Read commands from rcfile
```

Insert/Overtyping Mode

Insert/Overtyping Mode is solely for entering text. To leave one of these two modes press the [ESC] key. If you wish to enter the ESC character or any other control character while in insert mode: type [CONTROL]-V and then the control sequence. The only difference between Insert Mode and Overtyping Mode is that characters are placed in front of the text after the cursor in Insert Mode; whereas existing characters are overwritten in Overtyping Mode.

Command Mode

Entering Insert Mode

- a -- append text, after the cursor
- i -- insert text, before the cursor
- R -- enter Overtyping Mode
- A -- append text, after end of line
- I -- insert text, before first non-whitespace character
- o -- open new line below cursor in Insert Mode
- O -- open new line above cursor in Insert Mode

vi Syntax

vi commands follow the general form:

n operator *m* object

which means:

execute *operator* *n* times on *m* objects. If *n* and/or *m* are omitted, they default to 1. Operators which take objects are (if the operator is pressed twice then the object is the current line)

- *c* -- Change
- *d* -- Deletion
- *"c*_{*Y*} -- Yank, if *"c* is omitted, uses general buffer.
- *<* -- shift lines left by shiftwidth variable
- *>* -- shift lines right by shiftwidth variable
- *!cmd* -- filter through *cmd*

The operators *<*, *>*, and *!* are line based so the set of objects is diminished greatly.

Operators, which do **not** take objects:

- *s* -- Substitute
- *x* -- Delete character
- *r* -- Replace character
- *~* -- change case of character

Objects (if given with out an operator are interpreted as a cursor motion command):

- *w* -- forward until beginning of word
- *e* -- forward until end of word
- *b* -- backward until beginning of word
- *\$* -- forward until end of line
- *^* -- backward until first non-whitespace character
- *0* -- backward until first column of line
- *nG* -- line number *n*
- *n|* -- column *n* of current line
- */pat* -- forward until beginning of *pat*, search
- *?pat* -- backward until beginning of *pat*, backward search
- *n* -- repeat last search
- *N* -- repeat last search/backward search, but in opposite direction
- *%* -- until match of parenthesis, brace, or bracket
- *t*c** -- until next appearance of *c* on current line
- *T*c** -- backward until next appearance of *c* on current line
- *f*c** -- until and including next appearance of *c* on current line

-
- `FC` -- backward until and including next appearance of *c* on current line
 - `;` -- repeat last `f`, `F`, `t`, or `T`
 - `,` -- repeat last `f`, `F`, `t`, or `T` in reverse
 - `}` -- forward until end of paragraph
 - `{` -- backward until end of paragraph
 - `)` -- forward until end of sentence
 - `(` -- backward until end of sentence
 - `]]` -- forward until end of section
 - `[[` -- backward until end of section
 - `nH` -- *n* lines before first line on screen; *n* defaults to 0
 - `nL` -- *n* lines before last line on screen; *n* defaults to 0
 - `M` -- the middle line of the screen
 - `j` -- down one line
 - `k` -- up one line
 - `h` -- left one character
 - `l` -- right one character
 - `[BS]` -- left one character, backspace usually equals `^H`
 - `[SPACE]` -- right one character
 - `_` -- the entire current line
 - `-` -- until first non-whitespace character on previous line
 - `+` -- until first non-whitespace character on next line
 - `[RETURN]` -- until first non-whitespace character on next line

Miscellaneous ¹

- `u` -- undo last change
- `U` -- undo entire line
- `"cP` -- put `"c` or general buffer after the cursor
- `"cP` -- put `"c` or general buffer before the cursor
- `mC` -- set mark with character *c*
- ``c` -- goto mark *c*
- `'c` -- goto beginning of line with mark *c*
- ```` -- return to position before mark jump or search
- `''` -- return to beginning of line before mark jump or search
- `J` -- join two lines
- `D` -- delete rest of line
- `C` -- change rest of line
- `Y` -- yank current line into general buffer

-
- & -- execute last ex-style substitution
 - . -- execute last modification
 - ! *object command* -- send *object* as stdin to *command* and replace with stdout
 - [Ctrl]-G -- print information about file
 - :map *x y* -- when character *x* is pressed, execute *y*
 - :map! *x y* -- map input mode character *x* to string *y*
 - :ab *x y* -- *x* is an abbreviation for *y*, changes are made on the fly
 - :su -- Suspend the current editor session
 - :sh -- run a shell
 -

ex Commands

ex syntax

ex commands in the *vi* follow this general form:

: Address *command*

Which means:

Execute *command* on specific lines obtained from the address part of the general form.

If address is omitted, current line is used. Keep in mind that the *ex* is a line-based editor; so all actions are line based.

Addresses:

- % -- all lines in file
- x,y -- lines x to y
- . -- current line
- n -- line number: n
- \$ -- last line of file
- x-n -- n lines before line x
- x+n -- n lines after line x
- /pat/ -- forward to line containing pat
- ?pat? -- backward to line containing pat

Some commands are:

- s/pat/text/ -- substitute 1st match of pat with text
- s/pat/text/g -- substitute every match of pat with text
- s/pat/text/n -- substitute the nth occurrence of pat with text
- ya *c* -- yank into buffer *c* or the general buffer if *c* is omitted
- g address cmd -- execute cmd on all lines which satisfy address
- > -- shift right
- < -- shift left
- d -- delete line
- ! UNIX-cmd -- execute UNIX-cmd on line
- m address -- move lines to address

-
- refer to *ex* manual page for more commands

The *vi* environment variables

set

You can customize your environment with this command by typing `set var=value`, this will set the specified `var` to `value` for a scalar variable. For Boolean variables, use `set var` to set and `set novar` to unset. You can see which variables are set by just typing the `set` by itself. You can see a list of all variables by typing `set all`. Some environment variables are specific to the *ex* editor and some are specific to the *vi* editor. I have included both.

Boolean variables:

- `autoindent(ai)` -- begin editing next line at same level of indentation as this one.
- `autowrite(aw)` -- write current buffer before leaving
- `exrc(ex)` -- tells *vi/ex* if it should read the `.exrc` file in the current directory.
- `errorbells` -- editor sends a beep to the terminal when an incorrect
- `ignorecase(ic)` -- ignore case of characters in searches.
- `list` -- place a `$` at the end of each line and a `^I` on each tab.
- `magic` -- allow `.`, `[`, and `*` to be interpreted as special characters in RE's.
- `number(nu)` -- number lines in left margin
- `showmatch(sm)` -- when closing a paren., brace or bracket; move the visual cursor to opening item to check scope
- `showmode(smd)` -- show type of insert mode
- `wrapsan(ws)` -- when searching and at bottom of file, continue searching from the top
- scalar variables:
- `shiftwidth` -- number of spaces to to insert on a shift operation

File Saving and Loading

- `:wq` -- write file and quit
- `:w` -- write file
- `:w file` -- write to specified file
- `:w!` -- overwrite existing file
- `:e file` -- edit new file
- `:r file` -- put contents of file
- `:q` -- quit the editor
- `:q!` -- force quit the editor, do not save changes
- `:x` -- quit the editor, save file if it was modified
- `ZZ` -- quit the editor, save file if it was modified

-
- :n -- start editing next file in list
 - :rew -- rewind file list, start editing 1st file on argument list again
 - Q -- quit vi and enter ex
 - :pre -- Preserve file.
 - :rec *file* -- recover *file*

Examples ²

- j -- move cursor down
 - k -- move cursor up
 - h = [BS] -- move cursor left
 - l = [SPACE] -- move cursor right
 - + = [RETURN] -- first non-whitespace character on next line
 - cw -- change word
 - dd = d_ -- delete line
 - yy = y_ -- yank current line into the general buffer
 - "ayj -- yank current line and one below into buffer a
 - yfc -- yank until next occurrence of c on current line into the general buffer
 - 3dl = d3l -- delete next 3 characters
 - 4c(= 2c2(= c4(-- change next 4 sentences
 - >% -- While on a brace, paren., or bracket; shift right until closing brace, etc.
 - :%!sort = :1,\$!sort -- sort current file
 - :5,10s/foo/bar/2 -- change the second occurrence of foo with bar on lines 5-10
 - 3J -- Join next 2 lines to current one
 - 3,9m\$ -- move lines 3 through 9 to the end of the file
 - ab w/o with out -- when w/o is typed change to with out
 - :?foo?,/bar/d -- delete from the reverse match of foo until the next match of bar
 - g/{/,/}/< -- shift all lines between, and including, a "{" and a "}" left
 - :\$-4,\$d -- delete last five lines of buffer
- :%s/^\(.*\) \(.*\)\$/\2 \1/ -- swap everything before and after the first space